ENERGY CENTER OF WISCONSIN

Proposed Methodology for Assessing Achievable Potential for Energy Efficiency and Renewable Energy In Wisconsin

Report to the Advisory Committee of the Governor's Task Force on Energy Efficiency and Renewables

Prepared by
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Update 12/01/04

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Introduction

At the request of the Governor's Task Force on Energy Efficiency and Renewables, the Energy Center of Wisconsin is preparing a statewide study of achievable potential for electric and natural gas energy efficiency and customer-sited renewable energy in Wisconsin for all sectors. The study will focus on achievable potential within a five-year period beginning in 2006. However, we will also extrapolate the study results to a 10-year horizon that assumes continuation of efforts in Year 5 for five additional years. When completed, the study will provide information for the future determination of the level of state public benefits funds to be devoted to energy efficiency and renewable energy programs.

The study was initiated in July, 2004 and is scheduled to be completed by June 2005. Funding for the study is provided by Alliant Energy, Xcel Energy, Madison Gas and Electric, Superior Water Light and Power, We Energies, Wisconsin Public Power Inc., and Wisconsin Public Service Corporation. The preliminary budget for the study is $400,000 with a final determination to be made by the Advisory Committee[1] after the completion of Phase 1 of the study.

This document represents a summary of the proposed methodology for the study and is the product of Phase 1. This document also contains options for the Committee to review to expand the preliminary plan to include more markets or sectors or to include a time of day analysis of the findings. This summary represents the Energy Center's review of similar studies done elsewhere in the country, goals and objectives of the Governor's Task Force, existing data and studies conducted recently in Wisconsin for individual utilities, and the last study done for the state in 1994 by the Energy Center.

The methodology represents a market-based approach of each selected market or sector which may include single measures or a bundle of interventions in a market. The 36 markets which are proposed herein represent the Energy Center's judgment of the most promising markets for energy efficiency and renewable energy in Wisconsin. The Advisory Committee will have the opportunity at the November 1, 2004 meeting to review this list and make suggestions, changes or additions as appropriate. The Advisory Committee will also have the opportunity to discuss the methodology to determine if any changes might be made that would improve the usefulness to the Task Force, The Public Service Commission, or the Focus on Energy program.

[1] Oversight committee appointed by the Governor's Task Force on Energy Efficiency and Renewable Energy (see Appendix D).

Summary of Key Elements

Key elements of the proposed approach to assessing the achievable potential for energy efficiency and renewable energy in Wisconsin are as follows:

- The study will be a top-down examination of markets and areas for program opportunities in energy efficiency and renewable energy potential — The study will be organized around 36 markets and program areas thought to represent a significant majority of the state's potential.

- The study will focus on *achievable* program potential — This is the potential that can realistically be expected to be achieved within the study time frame based on explicit programmatic approaches.

- The study will involve an open process for delineating program options for the selected markets — We propose a series of open meetings with the Advisory Committee and interested stakeholders to elicit input on program designs in the target markets.

- The study design will be modular and updatable — The study will be implemented such that additional markets can easily be added to the mix at a later time, and assumptions about markets in the study can be updated with better information in the future

- Achievable potential will be reported in terms of net, program-induced impacts — Estimates of kWh, kW and therm savings will be net of impacts due to naturally occurring efficiency improvements, and will also include (separately tracked) estimates of broader market effects where applicable.

- Results will be couched in terms of supply curves — The primary results of the study will be charts relating total achievable potential and per-unit levelized cost (e.g., cents/kWh) to program spending.

- The study will explicitly acknowledge uncertainty — All study inputs will be in the form of ranges. These will be combined probabilistically to produce estimates of uncertainty in the results.

- The study will be based on secondary sources of data — We do not intend large-scale primary data collection under this study (though we may conduct some limited data collection in targeted areas). However, the study will identify areas where significant reduction in uncertainty could be obtained with additional primary data collection.

Scope

There are three scope dimensions for the study: (1) markets and technologies considered by the study; (2) time frame for the analysis; and, (3) geographic scope and disaggregation.

We have divided the energy efficiency areas into three broad categories:

1. incremental opportunities — markets in which goods are bought and sold that represent opportunities for program intervention to promote the purchase of more efficient options.

2. retrofit — areas of "latent potential" in which programs seek to stimulate people to take actions that would not otherwise occur to improve energy efficiency.

3. new construction — energy efficiency upgrade opportunities associated with the construction of new homes and businesses. Technically, new construction is a subset of incremental opportunities, but it presents a unique array of market actors, so we have treated it separately.

(Because renewable energy technologies are new and relatively unfamiliar to consumers, these markets are similar in nature to the retrofit markets above.)

Note that these broad categorizations gloss over to some extent the fact that some programs do in fact affect both incremental and retrofit opportunities. The methods we will outline shortly are flexible enough to handle these nuances.

We will refer to these areas collectively as "markets" even though for some program areas, the only market activity that occurs is in fact that stimulated by the program.

In terms of the specific markets included in the study, our original statement of work proposed that the study encompass 36 markets. We prepared a preliminary list of markets to be included in the study in our statement of work. The Advisory Committee of the Governor's Energy Task Force made some suggested changes at its July 9th meeting on the study. The Subcommittee also recommended that the selected markets include the following constraints: (1) only customer-sited renewable energy options be included (both grid-connected and off-grid) and (2) utility-based load management programs be excluded from the study scope.

We made some changes to reflect these recommendations, and then solicited stakeholder feedback on this revised list. That solicitation and the responses we received are included in Appendix B. The feedback we received contained three suggestions for markets to be dropped from the study scope, but contained many more recommendations for markets to be added to the scope.

In particular, Wisconsin Energy Conservation Corporation prepared a detailed response to our solicitation that included a list of a dozen markets to be added to the scope of the

study, and Wisconsin Public Power Inc. suggested the addition (or substitution) of one additional market. Finally, we received two comments indicating that excluding load management programs from the scope of the study would detract from its value.

In addition, the Wisconsin Renewable Energy Network (WREN) board recommended that if only six renewable technologies could be entertained, commercial solar photovoltaic (PV) systems should be substituted for residential PV. However, the board recommended increasing the scope of the study to allow for seven or more renewable technologies. After further query from Energy Center staff, WREN board members suggested the following four technologies for inclusion:

- Residential grid-connected solar photovoltaic systems
- Industrial wood combustion and co-firing
- Energy-efficient, renewable new homes
- Commercial solar space heating

In response to this feedback, we have made substitutions for the markets that were recommended to be dropped. We have also listed the recommended additional markets in the section under possible scope enhancements at the end of this document.

The current recommended list of 36 markets is shown on the following page. Changes from the October list are noted in footnotes. Additional markets that we have identified but not included in the scope are provided in Appendix C.

Item	Market Type	Market Sector	Market Description
Commercial, Industrial, Agricultural			
1	New Construction[2]	Commercial & Industrial: Whole building: higher impact, state-of-the-art, LEED certified, sustainable, daylit construction.	Targets larger, owner-occupied buildings. Component: lower impact (lights and HVAC component substitution), used for smaller buildings or buildings where whole building approach is not likely. High Performance Building Design and Construction: a medium path between state-of-the-art construction and simple component substitutions, encompassing many measures of whole-building design, but widely applicable.
2	Incremental	Commercial & Industrial: Packaged HVAC Equipment End of Service Replacement	The market includes unitary HVAC equipment replaced at the time of failure of the existing unit. Expect that savings/cost will be weighted by population tonnage (3, 7.5, 15, 25 tons) for increasing efficiency of the replacement unit to Consortium for Energy Efficiency Tier 2.
3	Incremental	Commercial boiler (>300,000 Btuh)	Replacement for gas fired boilers over 300,000 Btuh mainly in health, education, and offices. Replacement size up to approximately 3,000,000 Btuh
4	Incremental	Commercial & Industrial Lighting Upgrade Opportunities [3]	1. Commercial Alterations: Opportunity to reduce lighting power density when remodeling in commercial spaces. 2. Potential Lost Opportunity Markets includes commercial remodeling market, and replacement of fluorescent and HID lighting equipment that has reached the end of service life.
5	Retrofit	Commercial and Industrial Lighting and Controls[4]	Includes market potential for retrofit of commercial and industrial fluorescent, HID, and incandescent lighting to best available source. Study will be careful to exclude incremental lighting upgrades from the market so there is no double-counting.
6	Retrofit	Commercial Chiller system improvements	Chiller system optimization to accommodate both improved controls and cooling tower measures, and improved chiller efficiency if replacement is included
7	Retrofit	Commercial Small HVAC system	This is a market to improve the operating efficiency of in-place unitary HVAC equipment, by measures that could include: fixing economizer controls, adding new economizers, damper repair, coil cleaning, refrigerant charge, and thermostats. May consider duct and other measures if they can be delivered by same market actors
8	Retrofit	Commercial Supermarket and Packaged Refrigeration	Specific market and measures TBD. Grocery store: display cases, central refrigeration mechanical & control. Packaged stand alone refrigeration includes: Solid-door and open reach-in refrigerators and freezers; Beverage merchandisers; Ice-makers
9	Retrofit	Industrial Motor End of Service Repair and Replacement[5]	Includes the energy savings potential for efficiency upgrade from EPACT standards to NEMA premium efficiency motors. Market intervention would encompass downsizing where appropriate. Intervention would also encompass improvements in rewind practices for failed motors.

[2] Combined two new construction markets.
[3] Added lighting replacement to the commercial alternation (lighting remodeling) and expanded to include industrial.
[4] Expanded to include industrial.

Item	Market Type	Market Sector	Market Description
10	Retrofit	Industrial Compressed Air System Optimization	Includes a range of best practices measures. Will use market studies to encompass measures including leak detection and repair, reduce system pressure, eliminating inappropriate uses, variable inlet volume or VSD controlled screw compressors, and properly sized and controlled compressor.
11	Retrofit	Industrial Fan System Optimization	Includes a range of best practices measures. Will use market studies to encompass measures including electronic adjustable speed drives, efficient motors, sizing, maintenance, and airflow.
12	Retrofit	Industrial Pump System Optimization	Includes a range of best practices measures. Will use market studies to encompass measures including electronic adjustable speed drives, efficient motors, sizing, maintenance, and flow.
13	Retrofit	Manufacturing Process Retrofits	Will work with Stakeholders to select a limited number of process technologies that represent the best near term opportunities for conversion. Paper industry (several measures), food (ammonia refrigeration), and process heating are candidate measure categories.
14	Retrofit	Water treatment/supply	Includes a range of best practices measures. Will use market studies to encompass measures including electronic adjustable speed drives, aeration measures, motors, sizing, and maintenance.
15	Retrofit	Agriculture	Dairy will use a single savings number representative of a package of measures. Will work with Stakeholders to estimate fan (livestock) and pump (non-dairy) savings in agriculture.
Residential			
16	Incremental	Homeowner/renter electronic appliance purchase (TV, computer, etc.)	This market involves homeowners or renters who are in the market to purchase electronic products such as TVs, computers,etc. Potential estimates will likely primarily involve the promotion of Energy Star labeled alternatives.
17	Incremental	Homeowner/renter retail lighting purchase	This market involves homeowners or renters purchasing light bulbs for existing luminaires in homes and apartments, but may also incorporate efficient luminaire alternatives, such as torchieres. Potential estimates will be based on programmatic approaches to increasing the market share of CFLs. Does not include lighting fixtures for new homes, or those purchased for remodeling projects.
18	Incremental	Rental building common-area lighting purchase	This market involves multifamily building operators who purchase lighting products for common-areas in existing buildings. Potential estimates will be based mainly on the ability to substitute CFLs for existing incandescent bulbs, and LED or electroluminescent upgrade kits for exit signs. Does not include lighting purchased for new buildings or as part of building renovation projects.

[5] Added market in available position created by combining new construction markets.

Item	Market Type	Market Sector	Market Description
19	Incremental	Homeowner furnace replacement	This market involves homeowners purchasing new replacement furnaces. Since most furnace sales in Wisconsin are already high efficiency from a combustion standpoint, potential estimates will concentrate on programmatic approaches to encourage electrically efficient variable-speed models. Does not include systems purchased for new homes.
20	Incremental	Homeowner AC purchase	This market is defined as homeowners who purchase a new central air conditioning system, either as a new add-on or as a replacement to an existing system. Potential estimates will be based on programmatic options to encourage the purchase of units that are more efficient than the upcoming 2006 SEER-13 federal standard, as well as to encourage installation practices that optimize the performance of new systems. Does not include systems purchased for new homes.
21	Incremental	Rental heating system replacement	This market is defined as multifamily operators who are seeking to replace existing boilers. Potential estimates will be based on the program options to encourage high efficiency replacements, modular installations, and controls to maximize system performance. Does not include systems purchased for new buildings.
22	Incremental	Homeowner/renter retail room AC purchase	This market is defined as homeowners or renters who purchase a new room air conditioner. Potential estimates will be based on program options meant to encourage upgrading the EER of the unit purchased.
23	Incremental	Homeowner water heater replacement	This market is defined as homeowners who are in the market to replace an existing water heater. Potential estimates will be based on program options to encourage upgrades in the energy factor of the replacement unit, switching from electric to gas, switching from atmospherically vented to power-vented units, and the installation of on-demand units. Does not include systems purchased for new homes.
24	New construction	Single-family, owner occupied	This market embraces the construction of single-family, owner-occupied housing. Potential estimates will be based on program options to encourage more efficient building shells, higher efficiency mechanical systems, efficiency upgrades to appliances, and efficiency upgrades for hard-wired lighting.
25	Incremental	Homeowner remodeling	This market involves homeowners undertaking remodeling projects with energy-related aspects. Potential estimates will be based on program options to encourage insulation additions and air sealing during remodeling as well as efficiency upgrades for appliances and lighting purchased for remodeling projects. Does not include mechanical system replacements, as these are covered in other markets.
26	Incremental	1-4 unit rental remodeling	This market involves remodeling projects undertaken in single-family rental and small (2-4 unit) multifamily buildings. Includes shell insulation upgrades and air sealing, as well as appliance replacement and in-unit and common area lighting fixture replacement. Does not include mechanical system replacements.

Item	Market Type	Market Sector	Market Description
27	Incremental	5+ unit rental renovation	This market involves remodeling projects undertaken in larger (5+ units) multifamily buildings. Includes shell insulation upgrades and air sealing, as well as appliance replacement and in-unit and common area lighting fixture replacement. Does not include mechanical system replacements.
28	Incremental	1-4 unit rental refrigerator purchase	This market embraces purchases of refrigerators for single-family and small multifamily (2-4 unit) buildings. Potential estimates will be based on programmatic options to encourage the purchase of more efficient refrigerators. Does not include purchases for new buildings or as part of remodeling projects.
29	Incremental	Homeowner washer purchase	This market is defined as homeowners who purchase a new washing machine.
30	Incremental	5+ rental refrigerator purchase	This market embraces purchases of refrigerators for larger multifamily (5+ unit) buildings. Potential estimates will be based on programmatic options to encourage the purchase of more efficient refrigerators. Does not include purchases for new buildings or as part of remodeling projects.
		Renewable	
31	Retrofit/New Construction	Commercial	Solar PV (Electricity generation) This market includes existing buildings, commercial facilities and institutions, and building-integrated PV on new commercial and institutional construction, all grid connected
32	Retrofit	Commercial	Wood and wood waste (Thermal applications) This market covers Facility and process heat using wood and wood waste boilers
33	Retrofit	Commercial	Solar thermal (Thermal applications) This market includes businesses and institutions that use larege volumes of hot water such as car washes, hotels, hospitals and athletic facilities
34	Retrofit	Commercial/ Agricultural	Wind (Electricity generation) This market focuses on rural customer-sited turbines, 20 kW or greater
35	Retrofit	Agricultural	Anaerobic digesters (Electricity generation and thermal applications) This market targets farm-based anaerobic digesters for manure management
36	Retrofit	Residential	Solar thermal (thermal applications), This market includes domestic hot water systems for individual homes

The Energy Center will prepare a quantitative screen of these markets and others suggested for consideration based on recent similar study results in other states. The objective of the screen is to benchmark measures and markets contained in comparable studies to the Wisconsin market and estimate the percentage of overall energy efficiency potential that we can expect form this list of markets. The screening process results will be shared with the Advisory Committee so that any changes can be made to the market list if necessary to insure greater market coverage.

In terms of time-frame, the study will focus on achievable potential within a five-year period beginning in 2006. However, we will also extrapolate the study results to a 10-

year horizon that assumes continuation of efforts in Year 5 for five additional years. Note that these time frames refer to direct and induced market activity; the analysis of impacts from this activity will be conducted over the life of the measures installed, which may extend beyond the ten-year horizon.

Geographically, the scope of the study will be statewide. We will not develop utility specific data for the entire study. We will develop this information on request for individual utilities who want this information, at the conclusion of this study. This will require the collection of additional data from the utility and additional analysis which is outside the scope of this study.

We were also asked by the Advisory Committee to look into the feasibility of disaggregating achievable potential for low-income households. Given the market orientation of the study, we believe it would be difficult to do so within the context of the markets defined for the project—especially since low-income households are considerably less likely to participate in many of these markets. However, a possible way to achieve this end might be to add low-income weatherization as a distinct market included in the study, and estimate the achievable potential for this program area. This is also included in the list of potential scope enhancements at the end of this document.

Overview of Methodology

The primary goal of the study is to assess near-term achievable potential as a function of program funding level. We would argue that this assessment is best accomplished by articulating a set of fairly specific program options, since it is only in the context of these program approaches that what is technically and economically feasible beyond natural market activity can actually be achieved.

The overall approach for the study will thus be to first analyze and quantify the achievable potential for individual markets in the context of specific program approaches, and then to aggregate this collection of program approaches to develop an overall picture of achievable potential in Wisconsin in these markets.

The individual market analyses will involve assessments of:

- The total size of the market;
- The level of naturally occurring energy efficiency improvement in the market, and general market trends and developments of relevance;
- The nature and track record of program approaches in Wisconsin and other relevant states in this market, as well as consideration of novel approaches to intervening in the market;
- Estimates for program direct participation, costs, and impacts; and
- The likelihood of broad market effects beyond immediate program participants for key program approaches.

These analyses will be summarized and reported in 2-4 page “Market Snapshots” that will be backed-up with more detailed and fully referenced technical documentation.

Multiple program interventions with independent (or mutually exclusive) potential estimates are possible for a given market. The objective of theses analyses is not to produce detailed program designs, but rather to ground estimates of achievable potential in the context of realistic program approaches and capabilities.

For the overall analysis, achievable potential estimates for individual program approaches across markets will be aggregated to create supply curves for avoided electric energy (kWh), peak summer demand (kW) and gas use (therms). The curves will identify the approximate range of achievable potential associated with a given level of program funding or at or below a given avoided cost of energy (or demand). Two supply curves will be created for each of electric energy, electric peak demand, and gas energy: the first assumes that program funding is optimized to maximize the potential for the resource in question; the second assumes a program portfolio that maximizes the overall benefit-cost ratio of the programs across all three resources.

These supply curves will reflect 5-year and 10-year total spending and achievable potential. The 5-year estimates will incorporate modeling of program ramp-up effects; the 10-year estimates will be based on a simple extrapolation of Year 5 estimates for an additional 5 years.

Uncertainty in the analysis will be assessed by specifying all inputs into the analysis (such as per-unit impacts, program participation rates and program costs) in the form of ranges reflecting uncertainty in their true values. These will be carried through the analysis probabilistically (i.e. using Monte Carlo simulation), to produce estimates of uncertainty in all results. All results will be presented in the form of ranges representing 90% confidence intervals.

Detailed Methodology

The detailed methodology for the study is described in the following sections:

- Data gathering for individual markets
- Quantification of achievable potential within individual markets
- Aggregating markets to estimate overall potential
- Treatment of uncertainty
- Reporting elements

Data Gathering for Individual Markets

The process for analyzing each market will be to gather information about the market, assess programmatic options to stimulating the adoption of energy efficiency or renewable energy in the market, and then estimate the inputs for a quantitative model of efficiency potential.

The first step will be to gather relevant data on each market. The overall goal of this step is to generally characterize the size and nature of each market, as well as the historical track record of energy efficiency or renewable energy programs in the market.

The data gathering process will emphasize recent Wisconsin-based data, most notably:

- Data assembled for the recent potential studies for We Energies and WPS
- Focus on Energy program data, market research reports, and evaluation reports
- Energy Center of Wisconsin market research and market tracking data

Where appropriate, we will extend this search to program data, market research and evaluation reports in these markets in other states.

Because a key element of our approach is to articulate program approaches within the targeted markets, we believe it would be beneficial to hold a series of open stakeholder meetings where program implementers and others can discuss program options and help frame the appropriate programmatic context for each market. These meetings will also be beneficial for identifying additional data sources relevant to the target markets.

We propose a series of nine all-day meetings, covering four markets each. These will be scheduled well in advance, and will be based on an assumption that individuals will only attend portions of relevance to them. We will tape these meetings, and prepare detailed summaries of the discussion for inclusion in the technical documentation for the project.

Quantification of Achievable Potential

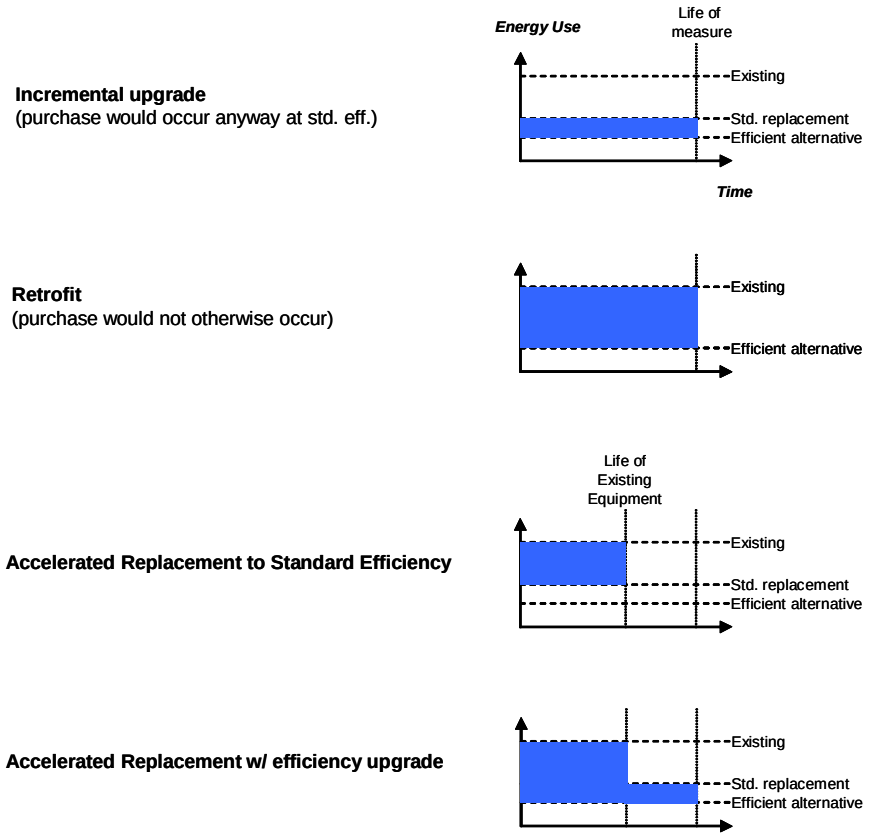
After gathering data and stakeholder input on each market, we will develop a quantitative model of achievable potential in the market. In general, this potential is a function of four factors: (1) per-unit impacts, (2) life of the measure(s), (3) the number of units affected by the program, and (4) the program cost of achieving these impacts.[6]

Per-unit impacts and lifetime

For energy efficiency programs, per-unit impacts are the average summer peak kW, annual kWh and therms of gas reduction for each affected unit. How these impacts are defined—and the period of time over which they are incurred—depends on the nature of the market and program intervention under consideration. However, the overall guiding principle is that per-unit impacts and measure lifetimes must be relative to what would occur in the absence of a program.

The following figure illustrates some of the various possibilities for savings and measure life. Some programs operate in existing markets where a household or business is already shopping to replace a piece of equipment. In this case, the program impacts are based on the difference between the piece of equipment purchased under the program compared to what would have been purchased had the program not been in place.

[6] The definition of a *unit* will vary across markets: for many markets, a unit is a household or business, but for some markets it makes more sense to define a unit as an individual piece of equipment, such as a light bulb.



In other cases, a program may cause an individual or business to take action to improve efficiency that otherwise would not have occurred. In this case, the program-induced impacts are calculated relative to an existing end use.

In addition, programs may accelerate the adoption of higher efficiency equipment that would eventually be replaced anyway. Under this scenario, impacts are relative to existing equipment, but the period over which these impacts occur is the amount of time between when the upgrade was implemented under the program compared to when it would otherwise have been undertaken.

Finally, a program may both accelerate the replacement of a piece of equipment and increase the efficiency beyond what would otherwise occur.

A particular program may in fact stimulate impacts from more than one of the above scenarios. For example, a program providing incentives for high efficiency equipment may cause some purchasers who were already in the market to simply upgrade to a higher efficiency, but may also stimulate additional households or businesses to replace the equipment earlier than they otherwise would have.

The analysis of per-unit impacts for each program scenario within each target market will be based on the unique characteristics of that scenario, and these analyses will have the flexibility to handle more than one type of impact. Some markets represent a single measure or technology, while others comprise a number of potential measures. In the case of the latter we conduct limited bottom-up analysis to estimate the typical impact and lifetime of energy efficiency improvements in the market.

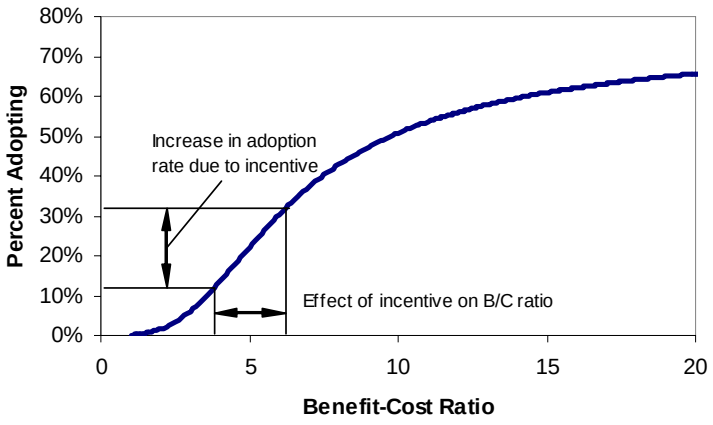
For renewable energy potential, the situation is considerably simpler: per-unit impacts are the estimated average production (and peak demand contribution) of the system under consideration, and these impacts occur over the life of the system.

Program-induced participation

Achievable potential is strongly related to the number of households or businesses that can be influenced (either directly or indirectly) by a program, and it is arguably estimating these participation levels that pose the greatest challenge to assessing achievable potential. Program participation is driven by a host of factors that have to do with the nature of the barriers that prevent people and businesses from adopting efficient alternatives, as well as the attractiveness of program incentives and the success of program efforts to reduce non-financial barriers.

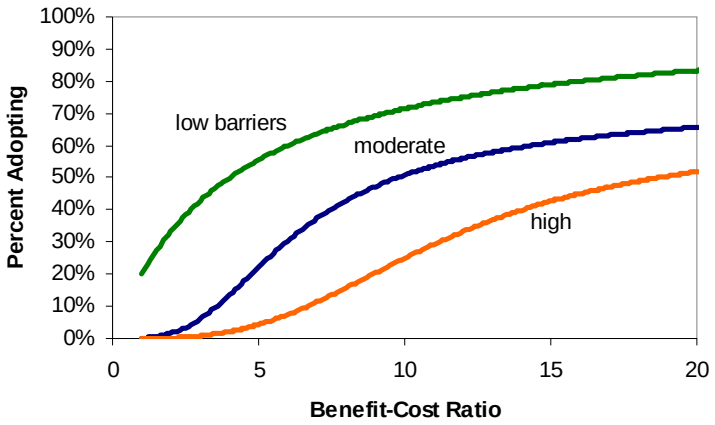
We propose to model the participation stimulus from financial incentives using an approach that has been employed in other potential studies. We will also model other factors that may place upper limits on participation levels.

The model of program participation from financial incentives is based on a functional relationship between the adoption rate for an efficient alternative (or renewable energy technology) and the payback or benefit-cost ratio to participants. It goes without saying that the shorter the payback period, the more likely it is that a given individual or business will upgrade to an energy efficient alternative or purchase a renewable energy system. If the functional relationship can be determined for a particular market or technology, then the stimulative effect of financial incentives can be quantified, as illustrated in the figure below. This stimulative effect is not likely to be linear, but rather will depend on the benefit-cost ratio both with and without the incentives.



The difficulty lies in defining the above functional relationship, which implicitly accounts for the discount that people place on future savings due to a variety of factors. Though there is a theoretical basis for this approach, and other potential studies (most notably recent ones conducted in California) have used such curves, there is also no small amount of uncertainty involved in their formulation.

We will use the existing literature to assess the appropriate range of possibilities for these adoption curves, and then to incorporate that range in the uncertainty analysis. Specifically, we envision defining a series of generic curves representing a range of possibilities, as shown below. Each market in the study (or at least those involving financial incentives) will be classified as being somewhere within the boundaries formed by two of these curves.



The above approach affords a generic framework for assessing direct program participation for programs that provide financial incentives. However, not all programs are oriented around providing financial incentives. Where appropriate, we will use (and document) other methods to gauge program participation.

The analysis for all markets will also take into account limits on program participation. In some cases, the potential market is constrained by the size of the market—one cannot upgrade the efficiency of more units than are sold in a given year. In other cases (particularly retrofit markets), the limits have more to do with gaining the awareness of decision-makers in order to take action. Finally, there are markets where constraints on the ability to deliver goods or services promoted by a program are the limiting factor.

A realistic analysis must also account for ramp-up effects for programs that are not already active in the state. Historical participation rates for similar programs in Wisconsin and elsewhere will be used to gauge appropriate boundaries on program participation and ramp-up rates.

Because the estimates of achievable potential must reflect net, program-induced impacts, it is vital that the analysis account for free ridership (particularly for incentive programs), since this reduces the effective number of participants influenced by the program.

On the flip side, programs may have broader market impacts beyond immediate participants—and programs with a market transformation orientation are specifically meant to do so. Where broad market effects are probable, the analysis will include estimates of the range of these impacts over the study time frame. While these effects could be substantial, it must be recognized that broad market effects are difficult to quantify, even retrospectively. While these effects have the potential to be large, they are also likely to be particularly uncertain. As with all other inputs to the analysis, we will model the uncertainty of broad market impacts. However, given the potential for this uncertainty to overwhelm more well-defined direct program impacts, we propose that the results of the study be presented both with and without indirect market effects included.

Program-costs

Estimates of program costs will be divided into fixed costs that are independent of participation levels, and variable costs per (direct) participant. These will be based on historical data for similar programs wherever possible. The overall analysis will also include a percentage adder to account for overall portfolio administration, marketing and evaluation.

Input Data Organization

The figure on the following page shows a draft concept for the basic data input for an energy efficiency program in a particular market, using an incentive program for high efficiency air conditioners as an example. All inputs are entered in terms of low/high ranges to accommodate uncertainty. Note that this input structure also reflects some simplifying assumptions: for example, per-unit impacts and variable program costs are assumed to be constant across the five-year analysis time frame.

Program: **Incentives for high-efficiency central AC**
Units air conditioners
Sector residential

Per-Unit Impacts

Savings

	Relative to existing		Relative to std. replacement	
	low	high	low	high
summer peak kW	0.2	0.3	0.1	0.2
annual kWh	500	800	100	200
annual therms	0	0	0	0

Modes (% of participants)	low	high
incremental upgrade	90%	95%
retrofit	0%	0%
accel. repl. to std. eff.	0%	0%
accel. repl. w/ eff. upgrade	5%	10%

Installation Cost

std.	$2,200
efficient	$2,700

Life

	low	high
measure life (years)	17	23
accelerated repl. (years)	1	5

Participation model

	low	high
Annual market (units)	90,000	110,000
Maximum adoption rate:	60%	80%
Barriers:	low	moderate
Incentive (% of incr. cost):	20%	40%

	Participation Limit	
Yr	low	high
1	5,000	10,000
2	10,000	25,000
3	25,000	50,000
4	50,000	90,000
5	90,000	110,000

Additional Market Effects (units)

	low	high
Year 1	0	500
Year 2	0	1,000
Year 3	0	2,000
Year 4	0	4,000
Year 5	0	8,000

Program Costs

	low	high
fixed, annual	$100,000	$200,000
per unit (non-incentive)	$25	$50

If we find that these assumptions are too restrictive for some or all markets, we may opt for a more generalized input formulation.

Life-Cycle Analysis

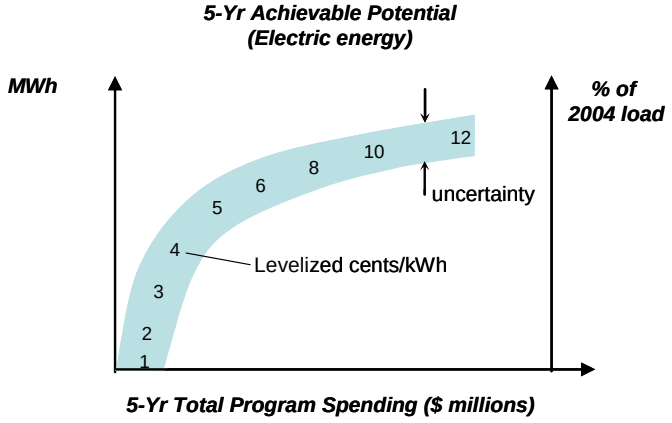
The inputs described above for per-unit impacts and measure life, direct and indirect participation levels, and program costs create a basis for calculating total program impacts by year extending total impacts over the life of the measure(s) installed each year due to direct participation and indirect market effects. While the assessment of program-induced activity is restricted to a ten-year time frame, the analysis of impacts will be conducted over the life of the affected measure(s). Using an appropriate discount rate (to be determined), we will levelize program costs across measure lifetimes to calculate life-cycle cost of conserved energy (and peak demand).

Analysis of Aggregate Potential

The analyses of individual markets will produce a set of achievable potential estimates for each modeled program approach. We propose to use utility avoided costs as the basis for estimating total achievable potential (we will work with the advisory committee to develop appropriate ranges for these avoided costs). Achievable potential (and program spending) estimates will thus be based on aggregating programs that deliver impacts at or below the appropriate avoided cost. These results will be presented in the form of ranges based on the probabilistic analysis of uncertainty (see Treatment of Uncertainty below).

In addition, we will develop supply curves for avoided energy and electric demand. These curves will show the relationship between total program spending, achievable potential and cost of avoided energy (or demand). To create a supply curve for avoided electric energy for example, we start with the program option with the lowest levelized cost of conserved energy. To this we add the total achievable potential of the option with the next lowest cost of conserved energy and calculate the cumulative savings and program cost across the two programs. The process is repeated until all program options across markets are exhausted. The end result is a curve depicting achievable potential as a function of program spending based on funding programs in declining order of cost effectiveness.

When the effects of uncertainty in the input assumptions are included, the single curve is replaced by a band representing the likely range of achievable potential versus program spending. The following plot is an illustration of this approach.



The report will present these results separately for electric energy, electric summer peak demand and gas energy (and will also separately assess energy efficiency and renewable energy potential—as well as disaggregating sectors within the energy efficiency category).

There is a wrinkle in this approach, however. The separate curves for electric energy, electric peak demand, and gas energy each implicitly assume a program mix that is optimized for that resource. If, for example, one's single-minded goal is to reduce electric peak demand, then at any given level of program funding one would choose programs that deliver the biggest bang for the buck in terms of peak load reduction. These programs would undoubtedly also deliver electric energy savings, but less so than if the same amount of program funding was instead optimized to deliver energy savings.

The three curves for electric energy, electric peak demand and gas energy will thus each represent the achievable potential for each resource individually. To provide additional perspective, we will also create separate supply curves representing achievable potential where funding is allocated in descending order of overall program cost effectiveness (based on avoided costs). In this scenario, funding is allocated first to programs with the highest overall cost effectiveness based on program costs and dollar benefits in the form of avoided electric energy, peak demand and gas energy. These curves represent optimizing not any single resource, but rather overall program cost effectiveness.

The combined result is a collection of six supply curves representing achievable potential for the three resources (electric energy, electric peak demand and gas energy) under two scenarios (optimized individually and for overall program cost effectiveness).

We recognize that actual program funding allocation decisions involve considerably more constraints and trade-offs than the scenarios described above. It is possible to find program mixes that are optimized in a more complex way, but this requires constraining the analysis in ways that run somewhat counter to the main objective of the study, which is to identify achievable potential as a function of program spending. For example, for a given level of overall program funding and threshold for avoided cost of electricity, it is possible to find the mix of programs that maximizes achievable potential while minimizing uncertainty. Such an analysis could incorporate additional arbitrary constraints, such as that no sector receive less than 10 percent of the total funding.

While feasible, this type of optimization adds complexity to the analysis, and would likely need to be conducted in the context of specific scenarios. We have included it as an optional addition to the study scope (see "Additional Optional Elements" below).

Treatment of Uncertainty

Uncertainty goes with the territory with studies of this nature, since estimates of program potential are derived from many assumptions about per-unit impacts, participation rates, etc. Our proposed approach to dealing with this uncertainty is to explicitly quantify it by specifying all input values in the form of ranges.

To propagate the uncertainty in the inputs through the analysis to the results we will use a Monte Carlo approach. This method works by repeatedly recalculating the results with random values (within the assigned ranges) substituted for each input value. These random perturbations create variation in the results from one iteration to the next. The distribution of these outputs over many iterations is a measure of the uncertainty in the results due to uncertainty in the inputs. We will report all results in the form of ranges that represent the 5^{th} and 95^{th} percentiles of the range of results from the Monte Carlo simulations. These ranges can thus be interpreted as 90 percent confidence intervals.

The implementation of this approach is flexible enough to allow for addressing mutually exclusive program options in a given market, as well as programs where the impacts may be correlated within (or across markets). We will address these situations as needed.

We will also conduct sensitivity analysis, and highlight factors that are key contributors to uncertainty in the overall analysis.

Reporting

The reporting for the project will be divided into three separately-bound documents:

1. Overview of achievable potential in Wisconsin
2. Individual market analyses
3. Technical documentation

We envision the contents of these documents to be as follows:

Overview Report

1. Executive Summary
2. Background
3. Short synopsis of scope and methods
4. Summary of achievable potential (overall and with various break-outs)
5. Recommendations to reduce future uncertainty

Individual Market Analyses

1. Introduction
2. 2-4 page summaries of individual markets

Technical Documentation

1. Technical details of overall approach
2. Documentation of (and references for) detailed data inputs for individual markets
3. Meeting minutes
4. References

Scope Enhancements Considered by the Advisory Committee

At the July 9 meeting of the Governor's Task Force Advisory Committee the Energy Center was asked to address several scope enhancements. At the November 1 meeting and in subsequent comments, the only scope enhancement supported by the Advisory Committee is the screen of all potential markets.

Utility Service Territory Disaggregation

The Energy Center was asked to assess the feasibility of disaggregating results by utility service territory, as well as the data and cost implications of such disaggregation. We believe it is feasible to provide at least a first-order disaggregation of achievable potential by utility service territory. By "first-order" we mean disaggregating the statewide study results across service territories primarily on the basis of customer segmentation. This disaggregation would also include climate adjustments for impacts related to space heating and cooling, as well as adjustments for renewable resources that vary significantly across the state. However, the analysis would not otherwise account for market differences across service territories, but would simply allocate the primary statewide results on the basis of the proportion of the market within each service territory.

Accomplishing this disaggregation would involve obtaining customer counts and total load from each utility by sector and zip code—as well as by SIC or NAICS code for commercial and industrial customers. These data will form the basis for disaggregating each market by service territory for each of the five major IOUs plus the WPPI system. The data will also provide a basis for developing climate and renewable energy resource adjustment factors to be applied to the disaggregation.

Cost: $35,000

Incorporation of Additional Markets

Respondents to our October 25, 2004 solicitation requesting feedback on the list of markets to be included in the study recommended adding a number of markets to the study. Detailed responses can be found in Appendix B. A compiled list of these recommendations is as follows:

<u>Renewables</u>

- Residential grid-connected solar photovoltaics
- Industrial wood combustion and co-firing
- Energy-efficient, renewable new homes
- Commercial solar space heating

Residential

- Single-family dehumidifiers
- Single-family central AC rehabilitation or early replacement
- Rental property water heater replacement
- Rental property laundry room equipment purchase
- 5+ unit rental new construction
- 5+ unit hot water savers (showerhead, aerator, tank wrap, etc.)
- Rental property water heater fuel switch

Commercial & Industrial

- C&I lighting end-of-service replacement
- Industrial motors, end-of-service replacement

Cost: $9,000 for each additional market included in scope
$3,500 for preliminary screening and ranking of possible added markets

Integration with FIDO

Paul Meier of Meier Engineering presented a proposal to integrate the potential study with a proprietary supply-side dispatch model at the July 9 meeting. The Advisory Committee recommended that the Energy Center work with him to develop a scope and budget for this proposal. A proposal by Meier Engineering and Kema is included in Appendix A.

Cost: $75,000 plus (depending on options)

Scenario Optimization

As described under "Analysis of Aggregate Potential" above, this add-on task will provide for the development of a more complex optimization of achievable potential under a series of up to five scenarios to be developed in consultation with the project Advisory Committee.

Cost: $20,000

Appendix A — Meier Engineering / KEMA Proposal to Integrate Study with FIDO

RESOURCE PORTFOLIO MODELING FOR ENERGY EFFICIENCY & RENEWABLES

October 25, 2004

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SUMMARY

Meier Engineering Research LLC (MER) and KEMA, Inc. (KEMA) submit the following adjunct proposal to the Energy Center of Wisconsin's (ECW) Assessment of Achievable Potential for Energy Efficiency and Renewable Energy in Wisconsin (the Achievable Potential Study).

ECW's proposed study is designed to quantify achievable efficiency potential in Wisconsin and to help establish appropriate funding levels. Once funding has been determined, it is prudent to maintain detailed accountability for spending, and to strive to maximize program benefits for Wisconsin businesses and citizens. This proposal offers a tool to scientifically benchmark and increase the cost-effectiveness of energy efficiency and renewable energy programs, and to improve transparency of program activities and benefits.

MER has recently completed development of FIDO™, a proprietary research model that evaluates the performance of energy efficient and renewable technologies "inside" an electric power system. Demand-side measures are integrated chronologically with system load and power plant performance, yielding accurate and uniform cost-benefit analysis.

To enable the rapid and rigorous evaluation of program design alternatives, the following services are proposed:

1) Incorporate the Achievable Potential Study's resulting data into FIDO.

2) Develop load shape data for each market.

3) Populate FIDO with load shape data and Wisconsin-specific supply-side data.

4) Provide licensed copies of FIDO to the Department of Administration, the Public Service Commission, lead program administrators, and the utilities funding this study.

SCOPE OF WORK

1) Incorporate the Achievable Potential Study data and methods.
FIDO's current modeling of technology markets will be modified as necessary for compatibility with ECW methodology, expanded to incorporate all studied markets with an electric component, and populated with the study's resulting data.

2) Develop load shape data.
KEMA, Inc. will develop impact load shapes that can be applied to the estimates of energy savings potential, to allocate the savings over hours and months. The load shapes will be developed based on prior studies. Sources of load shapes available for use include the following:

Midwest

- *residential end-use load shapes based on whole-premise metering data
- *residential end-use load shapes, based on end-use runtime data and whole-premise metering data
- *residential air conditioning metering data
- commercial/industrial load impact shapes by technology type developed for the Michigan Public Service Commission

Outside Midwest

- residential lighting load shapes from Tacoma and the Northeast, based on lighting logger studies
- *impact load shapes by sector and technology type based on a variety of methods
- commercial/industrial costing period allocations developed for California
- residential air conditioning metering data for California

Sources indicated by an asterisk would require consent of the sponsoring utility. A single asterisk indicates a study either based in Wisconsin or for a utility that currently has service territory in Wisconsin. Additional studies that Wisconsin utilities have conducted could be made available for this effort.

Three levels of effort are offered for this task:

A) Translate existing estimated end-use load shapes into appropriate shapes by sector and end use. The emphasis will be on reasonable allocation to broad costing periods, and effect on peak load. Some expert judgment will be involved. Basic load shapes will be developed for approximately 6 residential and 8 commercial/industrial/agricultural end uses. Load shapes for premise-wide initiatives will be estimated as a weighted average of the end use shapes.

B) Work similar to A), but with breakdown into finer time periods where possible. Additional engineering analysis will be done to develop reasonable curves for categories not well represented by existing sources. Adjustments will also be developed where appropriate to develop different impact load shapes by technology within an end-use category.

C) In addition to B), analyze existing metering data samples to develop new end-use load shape estimates.

3) Supply-side Modeling.
MER proposes two alternatives for supply side modeling:

a) detailed modeling of each utility service territory, or
b) a single, simplified and aggregated statewide model.

Detailed modeling of each service territory offers the highest degree of accuracy, but will require disaggregation of market data and individual versions of FIDO for each territory. A single statewide model will lose some granularity, but will be simpler for the end-user. Supply-side modeling will be based entirely on publicly available data.

4) Access, Registration & Support
FIDO will be made available on CD as well and via internet download. Because spreadsheet-based programs are difficult to secure, access to this model will require strict conformance to registration and licensing requirements. Sixteen hours of support and training are budgeted below.

BUDGET

1. Incorporate Achievable Potential Study Results	$17,000
2. Demand-side load shapes (KEMA, Inc.)	
Option A – as described above	$26,000
Option B – as described above	$35,000
Option C – depends on data sets provided.	$50,000 and up
3. Supply Side Modeling & Integration	
Option A - Simplified Statewide	$21,000
Option B - Detailed by Service Territory	$45,000
5. Access, Security & Support	$11,000

Estimated completion: August 1, 2005

The costs outlined above include a license for FIDO through 2006. Starting in 2007, recurring annual license fees are required to provide for data updates, model refinement,

and support as deemed necessary. License fees will be designed to directly cover MER's time and expenses, with the licensed users determining the level of effort necessary. A labor rate of $70 per hour guaranteed through 2007. If no additional effort is requested, FIDO may be re-licensed in 2007 for $15,000.

Appendix B — Stakeholder Feedback on Preliminary List of Markets to be Included

Solicitation for Feedback

October 6, 2004

TO: Stakeholders in Energy Efficiency and Renewable Energy Potential Study

FROM: Susan Stratton

RE: Markets and program areas for inclusion in Energy Efficiency and Renewable Energy Potential study

As you may know, the Energy Center is currently in the planning stage for a study of the potential for gas and electric energy efficiency and customer-sited renewable energy in Wisconsin. I am writing to solicit your (and your colleagues') feedback (by October 18th) on a preliminary list of markets and program areas to include in this study.

The study will focus on achievable potential over the next five years. It will also be organized around specific markets or program areas where program intervention can be expected to have the most potential impacts in this time frame. We have budgeted the study to provide detailed assessments of 36 markets and program areas (additional markets or program areas could be added at a later date if the Advisory Group determines it is appropriate).

We are seeking feedback from interested stakeholders about which 36 markets and program areas are most important to include in the study. Below is our preliminary list of markets and program areas for inclusion in the study (also attached is a more complete list from which our 36 was selected).

If you feel that this list excludes an area with significant achievable potential, please let us know by October 18th. Such an area could be either an existing market for a good or service where a program might stimulate the adoption of higher efficiency options ("incremental" or "new construction" markets), or a program approach that will stimulate an improvement in energy efficiency (or the adoption of a renewable energy technology) outside of existing markets ("retrofit" markets). To be most persuasive, you should describe how the market or program area you propose offers more achievable potential than other areas already on our list.

Return your comments to Sherry Benzmiller at the Energy Center, sbenzmiller@ecw.org. If you have questions about these markets, you may contact Energy Center staff directly:

Residential: Scott Pigg, spigg@ecw.org
Commercial, industrial, agriculture: Kevin Grabner, kgrabner@ecw.org
Renewables: Ingrid Kelley, ikelley@ecw.org

Feel free to pass this solicitation on to others who might be interested in providing feedback to us. We will incorporate this feedback into an overall study design that we will submit the project advisory committee on October 22.

Solicitation Responses

Wisconsin Energy Conservation Corporation – Janet Brandt, Rick Morgan, Kathy Kuntz, Jennifer Fagan

Thank you for the opportunity to comment on the markets to be modeled in the Potential study. This is an important study to the State in its long-term energy planning and as a stakeholder in the energy efficiency infrastructure, we stand ready to help however we can. Given that WECC is the Administrator of the Focus on Energy programs and other programs in the State and outside the state, we have expertise, experience, data and market knowledge that can help with the study. WECC also has a vested interest in the outcome being as accurate as possible as it might affect funding for the Focus programs long term. As a result, WECC is committed to providing market information, data, and advising as appropriate to assure that the study is accurate yet without WECC bias.

WECC will also work with ECW providing data from its Business Program Design Characterization Study that will be completed during the first quarter of 2005. The Characterization Study has the purpose of helping the Focus on Energy Business Programs gain important market information for its 2005 program planning. This same information can help ECW as input to the Potential Study and will be provided when available.

Concerning the list of market and program areas to include in this study, WECC found it difficult to fully respond to the listing as there was little explanatory information as to the study structure, methodology, and process for completing the study or the methodology for determining inclusion or exclusion from the list. WECC has had limited exchanges with Kevin Grabner to try to understand better the process used and expected approach to develop this response. At present, however, we think our response might be somewhat constrained by our lack of understanding regarding your proposed processes.

The second complication in developing the WECC response is the expected RFP for the BP Characterization Study, which is expected out this week. In that RFP there will be specific markets that will be identified which have overlap with the list you provided. WECC has received the notice of potential intent to bid from ECW so we cannot comment at this time on the scope of that study. (We want to ensure that there are no potential conflicts with an open and fair bidding process.) Once this RFP is issued, ECW can use that information to also help inform its planning process for the Potential Study.

Process

WECC has been asked to comment on the listing of markets and program areas to study. While our comments below are specifically on the market listing, we feel that it is important to also discuss the process to be used for determination of technologies, programs or markets included. WECC would like to suggest a meeting on a program level between WECC and ECW in November to discuss what Focus programs are currently utilizing, experiences in the market with market actors, and expected/desired changes that the Focus program is planning. This will allow ECW to understand and take advantage of the current market knowledge of the Focus programs. While we understand the primary purpose of the Study is to give the Public Service Commission the information it needs to set budgets, policy and goals, WECC hopes that the information will also help inform program planning efforts for Focus on Energy both short and long-term. There are three areas that would help Focus directly:

- The first are assessments of technologies or market areas that are not now considered within programs due to lack of market potential information and funding. The identification of the potential of these areas could help determine priority of funding and program efforts.
- The second area would be if the existing program technologies have additional potential that could be addressed with additional resources.
- The last area would be the potential and effects of enhancements under consideration by the programs.

Examples for each are provided below.

Not Currently Considered: Dehumidifiers (both incremental and retrofit) have been excluded from the current program and your listing of markets to be modeled. It is WECC's understanding that reducing dehumidifier energy use as a retrofit holds substantial potential since utility end-use studies show dehumidifiers' energy use are of the same order of magnitude as air conditioners in causing coincident peak load. Other states have offerings for this technology. Another example is existing air conditioners that perform poorly because of both inefficient equipment and the need to rehabilitate equipment. Again, WECC clients in other states have been interested in programs to either rehabilitate equipment (sometimes called re-commissioning) or early retirement of equipment with a retrofit. WECC could provide a listing of areas it believes are of high interest and potential for consideration.

Existing Program Expansion: The potential study should consider existing Focus programs and determine how much additional potential could be accomplished if adequate resources were available. Budget constraints have significantly limited what could be accomplished with the market place collaboration Focus on Energy has been able to establish. For instance, Home Performance with ENERGY STAR and Wisconsin ENERGY STAR Homes could achieve more results with additional money by expanding the number of non-WECC consultants promoting the whole house approach. More money for higher

rewards on things like dense pack insulation would certainly impact what is achievable. Large C&I markets might be impacted with more money for process incentives. Increased rewards could substantially increase the penetration into incremental markets and even lead to earlier retirement or retrofit of working equipment. Other Focus initiatives started early in the program but dropped due to budget constraints such as the BP New Construction program and the Residential "Close the Hole" program (eliminating the vertical flue), have gas and electric potential and should be assessed.

Enhancements Under Consideration: Enhancements under consideration for inclusion in Focus programs should be included in the achievable potential study. WECC continually works to enhance Focus programs. For example, the Efficient Heating and Cooling Initiative is considering a number of enhancements, especially since the Federal required minimum efficiency of air conditioners available will increase from a SEER of 10 to 13 in 2006. The potential study might consider quantifying the savings from the increase to SEER 13 which will be substantial. Additional enhancements under consideration include early retirement of very inefficient air conditioners, recommissioning air conditioners to perform at rated efficiency, modifying best practices for installation of new air conditioners (e.g., airflow, refrigerant charge, and proper sizing), modifying the relative reward levels between air conditioners, and incorporating results of STAC research (e.g., 2-stage air conditioner research). In the Commercial and Industrial sectors, other such examples are Energy Management systems and other types of controls (such as Guest Room Energy Management systems for hotels, and software management systems for computer networks.). These are just a few of the areas where enhancements to the Focus programs are continuing.

Response to Listing

Residential

- Refrigerators – incremental for homeowner currently included
    - Comment: Given the Federal Standards versus Energy Star standards there is little opportunity in this market. **This should be removed**
- DHW – incremental replacement currently not included
    - Comment: There is a huge opportunity for gas savings and for fuel switching especially if "closing the hole" flue replacement is a part of the retrofit. ***This market should be considered for modeling.***
- Dehumidifiers – currently not included
    - Comment: Studies by other utilities show potential on peak impacts that would make this worth investigating. ***This market should be considered for modeling.***
- Central Air Conditioners – currently not included

- Comment: Some recent research by WECC in MN has shown that central AC rehabilitation or early replacement have potential for significant savings (increase of 3 or more SEER). ***This market should be considered for modeling.***

Multi-Family & Rentals 1-4 unit and 1-5 unit

The following MF Energy Efficiency / Residential markets should be added to the Preliminary List of Markets Modeled:

- Energy Efficiency Residential Incremental Mechanical system purchase rental DHW replacement
  - **Comment:** There are excellent opportunities to convert existing electric hot water heating, to upgrade existing and planned new construction hot water heating using indirect-fired water heaters and high-efficiency, sealed combustion, condensing, modular boilers achieving 93+% efficiencies. There are several manufacturers of these systems that can serve both DHW and space heating loads and some very aggressive distributors in Wisconsin.
    This market should be reconsidered for modeling.
- Energy Efficiency Residential Incremental White goods purchase rental common laundry room equipment purchase
  - **Comment:** There are at least three factors that should be considered in determining if this market should be modeled: 1) We have new Wisconsin-specific monitored savings information; 2) Water and wastewater costs, though still low, are increasing rapidly and new washers save significant amounts of water; 3) Rental common laundry room washers and dryers are typically coin-op (or "card" vend) units provided by leasing firms. Innovative, aggressive programs could improve earnings for leasing companies and reduce owner/manager costs across the lifetimes of most leases.
    This market should be reconsidered for modeling.
- Energy Efficiency Residential New construction New construction 5+ unit rental
  - **Comment:** Three years of program efforts have identified a range of cost-effective opportunities to save energy and water in this market. Across the entire multifamily market from affordable to luxury housing, there is growing interest and parallel development of knowledge among designers.
    This market should be reconsidered for modeling.

- Energy Efficiency Residential Retrofit -Hot water savers measures to reduce hot water energy consumption (showerhead, blanket, etc.)
  - **Comment:** On their own or in combination with in-unit lighting upgrades, medium to large-sized apartment buildings are a very cost effective target for direct installation of hot water saving measures. Installing 6 CFLs, shower heads and bath and kitchen

faucet flow restrictors is especially attractive in buildings with electric water heaters.
This market should be reconsidered for modeling.

- Energy Efficiency Residential Retrofit fuel switch Residential water heating
    - **Comment:** Many owners/managers with access to natural gas service are excellent targets
      This market should be reconsidered for modeling.

- Renewables Multifamily Residential New Construction and Retrofit Solar Thermal DHW opportunities are more cost-effective than single-family opportunities. Larger loads offer the ability to install larger systems that obtain economies of scale. New construction is the best opportunity, but we have had significant success in retrofit applications.
  This market should be considered for modeling.

Commercial & Industrial

- C&I Small facility retrofit – currently included
    - Comment: This market is dominated by rental properties with little incentive to make alterations. We believe there are other markets with better potential. **Remove from modeling**
- C&I Lighting in large commercial, education and government – currently included
    - Comment: In addition to bulbs and fixtures, this analysis should also include lighting controls. ***The technologies analyzed for this market should be modified as noted.***
- C&I Lighting end of service replacement – not currently included
    - Comment: Lighting is a big part of the savings for Focus on energy whether it is new applications or end of service. Focus needs to understand what that potential is so that programs can be adjusted. In addition to bulbs and fixtures, this analysis should also include lighting controls. ***This market should be considered for modeling.***
- IN Motors end of service replacement – not currently included
    - Comment: Motors has been an important market for Focus and applied in many programs around the country. Though we have some good information on this market, we need to better predict its potential. ***This market should be considered for modeling.***
- IN Fans and Pumps – Currently included
    - Comment: These technology applications are fundamentally different and should be analyzed via separate markets. ***Modify market definition as noted.***
- IN Fans Boiler End of Service Replacement – Currently included
    - Comment: The markets for large vs. small boilers are very different and should be analyzed via separate markets. ***Modify market definition as noted.***

- Commercial HVAC system maintenance for EE – not currently included
    - Comment: Many HVAC systems are not properly maintained for energy efficiency. With the number of rooftop units and other commercial HVAC equipment that affects energy savings and peak savings, this is a large potential market. ***This market should be considered for modeling.***
- AG dairy farm, livestock and crop –currently included
    - Comment: This category has proven to be very difficult to model precisely. Focus uses a rule of thumb (from UW-Extension experts) of 700 to 900 kWh savings per cow to calculate potential savings. ***This market should be dropped from the detailed modeling and a simplified calculation should be used instead.***
- AG pumps and fans – not currently included
    - Comment: Agriculture is a large part of the State's economy. While it will be helpful to understand the facility retrofit, much of the energy savings is driven by fan and pump use. ***This market should be considered for modeling.***

Finally, while the potential study cannot study all aspects of energy use, WECC believes that the lack of potential information on load management alternatives would greatly reduce the value of the study from a policy perspective. Integration of load management with energy efficiency is good policy that will maximize the energy and dollar savings to the State long-term. These programs would not necessarily be administered through the Focus program, but the potential study should include all alternatives no matter what delivery organization or method.

We hope you have found these comments helpful and look forward to discussing this important study further.

Wisconsin Public Power, Inc. – Jake Oelke

Overall, the markets and program areas seem reasonable. One market that was not on either list is a focus on water/wastewater operations (e.g., motors, pumps, blowers, fine-bubble aeration). The Focus On Energy program has a developed a specific program for this market. Also, the Iowa Association of Municipal Utilities and the Iowa Energy Center recently did some survey work in this area. I believe the Consortium of Energy Efficiency has also developed a committee to explore energy efficiency for these types of facilities. This would indicate that there is substantial potential. This is also a market area that I think municipal utilities will buy into and make progress fairly easily.

Maybe the work being done already is adequate and we can gain enough knowledge of potential from these other groups. However, it may be worth considering this target as opposed to something like commercial lighting retrofits. If I understand correctly, there is an end-of-technology-life coming very soon for the manufacture of magnetic ballasts and T12 fluorescent lamps (which makes up the majority of commercial lighting) from EPAct. Is this something we will want to continue to develop programs around if a natural transition will occur anyway?

Department of Administration – Jim Mapp

Under Commercial Retrofit Lighting: I believe that one of the things that we did not anticipate was how much incandescent lighting is in place in commercial buildings, particularly retail stores but also food service. CFL replacements should be estimated particularly the new dimmable floods, spotsand other specialty bulbs.

The potential study should also examine the about to be released CEE specification for High Performance (High Output) T - 8 bulbs and matched electronic ballasts. This specification has the potential for replacing fixtures with 3 lamps at 90 watts with 2 lamps of 60 watts, a savings of 1/3.

Under Industrial Retro Facility: The usual approach to an industrial facility is to look at the manufacturing aspect. However, many industrial facilities have a large office complex with its associated lighting, office machines and food service. Also the high bay area in the manufacturing or assembly area and exterior lighting in parking facilities have many opportunities for efficiency improvement.

Under C & I New Construction: The potential impacts for the New Buildings Institute E-Benchmark guidelines should be used as a standard to examine the potential for savings in new construction and major retrofits.

Under Residential Lighting: The impact of CFL Spots, Floods and Can lighting should be explicitly laid out for their contribution to potential savings.

Under Residential White Goods: The refrigerator potential should include freezers under the general category of REFRIGERATION. AHAM has shipments, shipment weighted efficiency and Directories of models from previous years for both refrigerators and freezers.

Wisconsin Energy Conservation Corporation – Don Wichert

- Commercial PV should be added to the list, possibly with residential PV. Yes, they are different markets, but I would really like to do both if possible. If we are limited to 6 markets: the priority would be commercial PV (its bigger, easier and more cost effective than residential PV), residential PV (has big PR appeal). Both would be best.
- Maybe residential PV and residential solar thermal could be combined as they have the same housing characteristics.
- Wind: suggest making this "rural wind", which includes both farms, farm businesses and other rural businesses
- Wood and wood waste: suggest changing the word "plant" in "Fuel supplies near plant" to "facility" as we are also seeking institutional facilities (like schools and gov't)

I say we should advocate to do both residential PV and residential solar thermal because the cost to do both is similar to doing just one. If you make an estimate of the number of homes with solar access, you are 90 percent there for technical potential of either. I don't expect roof area to be a limit on either.

In the second assessment, economic potential, PV may lose out pretty quickly, but that still is a pretty simple calculation.

I think its important to have both of these residential markets looked at. With 30 other EE markets, I don't feel smug in advocating for a slight increase in the renewable base that will not cost any or hardly any more.

L & S Associates – Larry Krom

The study will be a top-down examination of markets and areas for programmatic improvements in energy efficiency and renewable energy potential — Rather than an exhaustive delineation of all possible improvements to all end-uses, the study will be organized around 36 markets and program areas thought to represent a significant majority of the state's potential.

There seem to be only 31 markets listed, 6 to be modeled and 25 not to be modeled. Is this correct?

Suggested Markets to Model:
Residential Retrofit Solar PV Individual home systems
Commercial Retrofit PV systems
Commercial Retrofit Solar thermal DHW For use by businesses and institutions that use large volumes of hot water such as car washes, hotels, hospitals, athletic facilities
Rural Wind Site dedicated wind generation
Agricultural Retrofit Methane recovery Farm-based anaerobic digesters
Commercial Retrofit Wood and wood waste Fuel supplies near application

The study will focus on achievable program potential — This is the potential that can realistically be expected to be achieved within the study time frame (10 years) based on explicit programmatic designs.

Good. A longer timeframe is more realistic.

The study will involve an open process for programmatic vision for the selected markets — We envision a series of open meetings with interested stakeholders to elicit input on program designs to stimulate renewable energy development and energy efficiency improvements in the target markets. As the details of the study get underway, working documents will be posted to the Governor's Energy Task Force web site at http://energytaskforce.wi.gov/index.asp

OK

The study design will be modular and updatable — The study will be implemented such that additional markets can easily be added to the mix at a later time, and assumptions about markets in the study can be updated with better information in the future.

OK

The study will explicitly acknowledge uncertainty — study inputs will be in the form of ranges. Results will be expressed through supply curves.

We need to discuss the uncertainty of these supply curves since they would express yearly incremental supply change, in addition to supply at the end of 10 years.

The study will be based on secondary sources of data — No new primary data collection will be implemented under this study. However, the study will identify areas where significant reduction in uncertainty could be obtained with additional primary data collection.

OK. You do not have the budget to collect primary data.

Energy efficiency and renewable energy potential will be reported separately — renewables and energy efficiency potential will be analyzed using the same methodology, but these will be reported separately.

OK

MSB Energy Associates, Inc. – Niels Wolter

2. To add Commercial PV (as suggested in the Board meeting) but there is not agreement on what should be removed. At the meeting Niels suggested replacing residential PV. Larry has suggested we replace residential solar thermal. I am asking, while the technical potential of residential solar thermal and residential PV are pretty much the same, which of these technologies could come closest to reaching its potential, with the help of the FOE program, within the next five (or ten) years? And let's remember that the Million Solar Roofs program is still out there promoting (mostly) residential PV.

Hummm... PV could meet 100% of a home's electric need... SHW 50% of hot water needs. Both need open roof areas. Payback for SHW is currently shorter. PV has more buzz around it. Once we can import lots on LNG, NG prices will drop... but prices will continue to increase until then....about six years from now. Electricity price should steadily increase...mostly if we choose to deal with global warming and include it in PV system cost. PV technology has lots of opportunity to drop in price, solar thermal really doesn't.

I think both have a large potential on homes... but both potentials are larger on businesses.

I vote of commercial Active solar thermal and commercial PV.... but it really depends on the electricity and natural gas price forecast and the forecast of PV system price.

Going back to your question

If it is five years I vote res solar thermal.... if it is ten years I vote res PV

* In Dane County about 20% of our gen/trans capacity is used for under 40 hours per year. This tells me that load management is very important. From what I know it looks like the residential load management potential may be the most valuable (at least in Dane county) because their load better matches the late afternoon peak.
* Regarding PV.... I believe that the largest potential is not residential retrofit systems but systems on new homes. New homes often do not have shaded rooftops, can be oriented appropriately to collect the solar resource, and systems should cost less to install. Of course the existing housing stock is greater than what will built in the next five years... none the less most of the rooftops of existing homes are not suitable for PV. This holds true for SHW too.

Another perhaps larger market are PV systems retrofit on the large flat roofs of commercial buildings.

Note that Larry Krom has done a biomass and wind technical potential study for Dane County.

RENEW Wisconsin – Michael Vickerman

I lean towards replacing residential PV, because the market for that application will be constricted unless a way can be found to bootstrap PV onto new home construction.

Appendix C — List of Markets Not Included in Scope

TYPE	MARKET CLASS	MARKET
Commercial Energy Efficiency		
Incremental	equipment purchase	furnace end of service replacement
Incremental	equipment purchase	Lighting: end of service replacement
Incremental	service purchase	HVAC system maintenance enhanced for energy efficiency
Retrofit	system retrofits	Large commercial - other, excluding lighting, HVAC, refrigeration
Retrofit	facility retrofit	low cost operations improvements
Retrofit	facility retrofit	small facility retrofit
Retrofit	fuel switch	Commercial water heating
Retrofit	fuel switch	Commercial space heat
Retrofit	fuel switch	Commercial cooling
Retrofit	load management	Commercial direct load control
Retrofit	load management	Large commercial interruptible pricing
Retrofit	load management	Standby power generation pricing
Retrofit	load management	Commercial time of use pricing with customer load shaping
Retrofit	load management	Commercial thermal energy storage
Industrial Energy Efficiency		
New construction	new construction	process equipment
Incremental	equipment purchase	Motor: end of service replacement
Incremental	equipment purchase	Lighting: end of service replacement
Retrofit	system retrofits	motor-driven systems, except fans, pumps, and compressed air
Retrofit	system retrofits	Steam system
Retrofit	system retrofits	Process heat
Retrofit	system retrofits	Refrigeration
Retrofit	system retrofits	lighting
Retrofit	system retrofits	HVAC
Retrofit	facility retrofit	Low cost operations improvements
Retrofit	fuel switch	Industrial process heating
Retrofit	load management	industrial interruptible pricing
Retrofit	load management	Standby power generation pricing
Retrofit	load management	industrial time of use pricing with customer load shaping
Retrofit	load management	industrial thermal energy storage
Agricultural Energy Efficiency		
Retrofit	system retrofits	dairy farm refrigeration equipment
Retrofit	system retrofits	lighting
Residential Energy Efficiency		
Incremental	White goods purchase	homeowner refrigerator purchase
Incremental	Mechanical system purchase	rental DHW replacement
Incremental	Mechanical system purchase	homeowner/renter retail dehumidifier purchase
Incremental	White goods purchase	homeowner secondary refrigerator removal
Incremental	White goods purchase	rental common laundry room equipment purchase
New construction	New construction	1-4 unit rental
New construction	New construction	5+ unit rental

TYPE	MARKET CLASS	MARKET
Retrofit	Shell upgrade	homeowner shell improvements (insulation, air sealing)
Retrofit	Shell upgrade	1-4 unit rental shell improvements (insulation, air sealing)
Retrofit	Shell upgrade	5+ unit rental shell improvements (insulation, air sealing)
Retrofit	lighting upgrade	upgrade building lighting
Retrofit	Hot water savers	measures to reduce hot water energy consumption (showerhead, blanket, etc.)
Retrofit	fuel switch	Residential water heating
Retrofit	fuel switch	Residential space heat
Retrofit	load management	Residential direct load control
Retrofit	load management	Residential thermal energy storage
Agricultural Renewables		
Retrofit	Wind	Commercial wind developers; wind cooperatives
Retrofit	Solar PV	Small remote systems for water pumping, fence recharging, lighting
Retrofit	Solar Thermal, water	Greenhouse heating
Retrofit	Solar thermal, air	Heating for livestock barns, storage buildings
Retrofit	Hydropower	micro-hydro technologies
Commerical Renewables		
Retrofit	Solar thermal, air	For use by businesses or institutions that need to heat warehouses, equipment storage, garages and other minimally occupied large spaces
New construction	Solar PV	Building integrated PV
Government/Institutional Renewables		
New construction	Geothermal	Ground and water source heat pumps for school campuses
Retrofit	Methane recovery	Municipal sewage plants
Retrofit	Methane recovery	Landfill gas
Retrofit	Solar PV	Educational demonstrations for schools
Retrofit	Solar PV	Remote systems for lighting; highway signs; radio transmitters
Retrofit	Solid waste	Municipal solid waste to energy
Industrial Renewables		
Retrofit	Biomass	Biodiesel and other biofuels for electrical generation and industrial process heat
Retrofit	Hydropower	Paper mill hydro upgrade and expansion at existing dams
Retrofit	Biomass	Pulp mill black liquor gasification
Retrofit	Biomass	Small scale biomass gasification combined heat and power
Retrofit	Biomass	Biomass combustion and co-firing
Residential Renewables		
New construction	Solar PV	Zero energy homes
New construction	Solar thermal DHW	Zero energy homes
New construction	Geothermal	Ground source heat pumps for individual homes
New construction	Passive solar design	Solar orientation and energy efficiency design for homes to decrease energy needed for heating and lighting
Retrofit	Solar PV	Retrofit PV systems for homes
Retrofit	Wood/biomass space heating	Individual home stoves/fireplaces using wood or other biomass
Retrofit	Solar thermal space heat	Solar thermal space htg. Systems for homes
Retrofit	Hydropower	micro-hydro technologies for rural residences

Appendix D — Advisory Committee Members

A.J. (Nino) Amato, Wisconsin Industrial Energy Group
Phyllis Dube, We Energies
George Edgar, Wisconsin Energy Conservation Corporation
Charles Higley, Citizens Utility Board
Charles McGinnis, Johnson Controls
Jill Osterholz, Alliant Energy
Keith Reopelle, Wisconsin's Environmental Decade
Ilze Rukis, Wisconsin Public Service Corporation
Michael Vickerman, RENEW Wisconsin
Laura Williams, Madison Gas & Electric Company
Brian Zelenak, Xcel Energy